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(54) Animal feed block and packaging method for block

(57) An animal feed supplement in solid block form may be made by:

(a) admixing an aqueous feed solution with solidifying and nutrient ingredients to prepare an aqueous feed supplement liquid;

(b) placing a plastic bag formed of a water soluble plastic film into e.g. a vertical-walled form as a mold;

(c) pouring the aqueous feed supplement liquid mixture into the plastic bag;

(d) storing the mold containing the feed supplement to permit its contents to solidify; and

(e) stripping the vertical-walled form from the resultant solid block to recover a solid block entirely covered by said plastic film.

A solid feed supplement has total water content 10 to 35 weight percent and comprises sugar, protein, sodium carbonate, sodium bicarbonate and magnesium oxide. The sugar source may be molasses, whey, pulp and paper industry (lignin sulfonate solution) wastes or corn steep liquor.

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This print takes account of replacement documents submitted after the date of filing to enable the application to comply with the formal requirements of the Patents Rules 1982.

SPECIFICATION

Animal feed block and packaging method

This invention relates to an animal feed supplement and, in particular, to a preservative coating for a solid animal feed supplement, and a method of packaging the solid supplement.

Molasses has been used for many years as an animal feed supplement together with additives such as phosphoric acid and feed nutrients such as urea, fats, and the like. Solid materials such as cottonseed meal have also been suspended in the molasses; however, difficulties have been experienced with maintaining a stable suspension of solid materials. The liquid supplements have been fed by application to fodder or by free choice feeding on lick-wheels.

Feed supplements have also been manufactured and marketed as solid blocks. The earliest blocks were pressed blocks which were formed by compressing mixtures of molasses and dry ingredients. Poured blocks, in which the ingredients are mixed with molasses and poured into containers where they solidify, are more recent developments. The earliest commercial poured block was prepared by evaporative heating of molasses similar to candy manufacturing as described in U.S. Patent 3,961,081. This block lacked water resistance, and melted at elevated storage temperatures.

The most recent advances in supplement blocks have been the poured chemical blocks, in which additives are used to gel molasses and form water-resistance solids. Large amounts of calcium oxide or magnesium oxide have been added to molasses and the mixtures have been heated to form solid supplements in the manner described in New Zealand Patent Specification No. 170,505.

Entirely chemically gelled and hardened poured blocks and their manufacture are described in U.S. Patents 4,027,043, 4,160,041 and 4,431,675. These blocks are prepared by the reaction of molasses, a soluble phosphate and the oxide or soluble salt of calcium and/or magnesium. No heating is required and the liquid mixture is poured into cardboard containers for solidification. Maximum hardness is attained by using both calcium and magnesium oxides.

Another method of manufacture of a poured block is described in U.S. Patents 4,171,385 and 4,171,386 in which the molasses is gelled with clay which is added with high shear agitation. Magnesium oxide is added to the liquid mixture and the hardness of the block can be increased by the addition of ferrous sulfate, as described in U.S. Patent 4,265,916.

These prior products have been used for free choice feeding of cattle on ranges or in pastures and are too hard for feeding cows in a diary or to beef cattle in a feed lot. Also feed ingredients such as sodium carbonate or bicarbonate cannot be included in these blocks without affecting their quality.

Unfortunately, all the aforementioned supplement blocks are affected to some degree by the environment. Usually the blocks lose from 1 to about 5 weight percent moisture in the few days immediately following their manufacture. In hot, dry climates, further loss of water can occur, to the extent that the blocks shrink and crack, resulting in an unattractive appearance. When exposed to elevated storage temperatures and high humidity, mold can also develop on the surface of the blocks, usually starting at the surface interface between the cardboard box and the block.

This invention comprises pouring aqueous, liquid block ingredients into a container formed of a thin film of a water soluble plastic. Surprisingly, it has been found that the liquid feed mixture can be poured directly into a container of a water soluble plastic film and the container will retain the liquid until it solidifies.

The container of a water soluble plastic can be a preformed bag with a wall thickness from 0.5 to about 10 mils, preferably from 1 to about 5 mils. The liquid mixture of ingredients is poured into the plastic bag which can be supported in a surrounding mold that is removed after the ingredients have solidified. The size of the mold can be varied over wide limits, from 1 to about 750 pounds, to prepare the most convenient feeding size for the particular application. Small, individual blocks, each weighing from 1 to about 5 pounds can be prepared for a single day feeding of an individal animal. Alternatively, large blocks from 20 to about 750 pouds can be prepared for free-choice feeding by a number of animals. The block market is typically supplied with blocks of 40 to 60 pounds, 250 pounds, and 500 pounds, each, and such sizes are also preferred when using the plastic film packaging of this invention.

This invention also includes preparation of a buffer-containing, solid, animal feed supplement which has the proper hardness and palatibility to achieve a daily animal consumption of 0.2–0.5 pound of sodium carbonate or bicarbonate and 0.07–0.15 pound of magnesium oxide with free choice feeding. The feed supplement is a solidified mixture of various feed ingredients with a feed solution of sugars or proteins, and mixtures thereof. The supplement is solidified by sodium carbonate, bicarbonate, or a mixture thereof, and magnesium oxide. The latter additives thus serve the dual purposes of solidifying the feed supplement and providing the desired buffer for the animal. The concentration of these additives is from 8 to 25 weight percent sodium

carbonate, bicarbonate, or mixtures thereof, and from 2 to about 5 weight percent magnesium oxide. Other feed ingredients can also be included, such as from 1 to about 35 weight percent natural protein feeds or eqivalent proteins such as urea, biurea and ammonium salts. Fat from either animal or plant sources can be included in an amount from 1 to about 20 weight percent. Calcium and/or phosphorus additives can be included such as calcium carbonate, dicalcium phosphate, defluorinated phosphate rock, etc., in amounts sufficient to provide from 0.5 to 1.5 weight percent calcium and from 0.5 to 1.5 weight percent phosphorus in the final product. Vitamins and trace minerals can also be included.

When the buffered supplement block is provided to animals which are not fed a high volume grain and forage diet, it may be necessary to increase the hardness of the block to limit consumption. The hardness of the block can be adjusted to any desired value by the inclusion of either, or both, phosphoric acid and lime (or calcium hydroxide) in amounts from 0.5 to 5 weight percent, each.

Other feed ingredients can be included in the liquid mixture before it is poured into the plastic film container. Examples of these feed ingredients include a source of protein in an amount from 1 to about 35 weight percent. Protein sources include natural protein feeds such as soybean meal, cottonseed meal, rape seed meal, sunflower seed meal, corn gluten meal, etc. which contain proteins at relatively high concentrations, e.g., from 10 to about 35 weight percent. Lower grade protein sources such as ground rice hulls, ground oat hulls, ground almond shells, ground walnut shells, etc. can also be used, as well as ground or cracked grains, e.g., cracked corn, oats, etc. For ruminants, equivalent protein sources can be used such as urea, biurea, and ammonium salts, alone, or in admixture with the aforementioned natural proteins. Also, products rich in "by-pass" protein can also be used such as bloodmeal, feather meal, etc. These are relatively high in protein content, from about 75 to 90 percent protein and are used at lower contents in the block mixture, e.g., from about 1 to about 10 weight percent.

THE FEED SUPPLEMENT (FOR EXAMPLE)

The feed supplements which are used for practice of this invention for example have the consumption set forth in the following table:

Table 1

Ingredient	Concentration in Final Product (Weight Percent) Broad	Preferred
Feed Solution	30-90	50-80
Sodium carbonate(1)	8-25	12-18
Magnesium oxide	2-5	3.5-5
Protein or non-protein nitrogen(2)	1-35	5-20
Fat	1-20	2-8
Vitamins	0-3	0.1-2
Minerals	0-4	0.1-2
Phosphorus source	0-8	1-3
Calcium source	0-8	1-3
Hardening agents(3)	0-10	0-6

(1) sodium carbonate, bicarbonate, or mixture thereof
(2) expressed as equivalent protein
(3) calcium oxide or hydroxide, and/or phosphoric acid

These supplements contain from 10 to 35 percent water, preferably from 15 to 28 percent water. Water is a component of the above ingredients such as the feed solutions. Where necessary, water can also be added as an ingredient to obtain the desired wate content in the final supplement.

The content of minerals, phosphorus and calcium, as well as other ingredients such as drugs,

vitamins, etc., can be varied as desired for specific applications. Examples of various minerals are manganese, iodine, zinc, copper, cobalt and iron compounds. In some specific applications, a high content mineral supplement is desirable, e.g., containing from 6 to 10 percent phosphorus, 5 to 8 percent calcium and from 0.1 to 2 percent of mineral salts, added as finely divided powders. These salts can be water insoluble salts such as dicalcium and tricalcium phosphate or can be water soluble salts such as monammonium phosphate. Examples of vitamins include Vitamin A, Vitamin D, and Vitamin E.

Examples of useful drugs are: growth promoting food additives or drugs such as monensin and sodium monensin, commercially available under the designation Rumensin from Eli Lilly Co.; chlortetracyline and sulfamethiazine; and mixtures of chlortetracycline and sulfamethiazine; etc. Other useful drugs include antiblat and antihelmintic agents as well as insect control agents. The aforementioned materials are used in effective concentrations for the desired result, e.g., drugs are used at concentrations from 0.5 to about 1.0 weight percent. The minerals are usually used in similar concentrations, but are often expressed in amounts from 3 to about 500 milligrams per pound and vitamins are frequently expressed from 10 to about 50,000 units per pound.

THE FILM COATING (FOR EXAMPLE)

Some blocks are surrounded by a film of a water soluble plastic such as polyvinyl alcohol, polyvinyl acetate, ethylene-vinyl acetate copolymers, and alkyl cellulose esters. These films are edible. Of the aforementioned, films of polyvinyl alcohol are preferred as these are generally recognized as safe packaging materials for food products. As desired, or necessary, the polyvinyl alcohol can be strengthened by the inclusion of from 5 to about 40 weight percent glycerol. Films of polyvinyl alcohol will slowly dissolve in water at ambient temperatures and will rapidly dissolve at temperatures of 150°F or greater. Despite this solubility, we have found that the aqueous mixture of ingredients can be poured into and retained in containers of the plastic at elevated temperatures. This permits the use of these containers to package the supplements which are poured into the containers at the elevated temperatures experienced during their preparation, which for most supplement formulations, is from 110° to 135°F. Although the supplement mixtures are aqueous suspensions and are poured into the plastic containers at such elevated temperatures, the plastic containers will retain the supplements. After the supplements solidify, the plastic film containers protect the supplement by retaining moisture and preventing growth of mold.

A microcide and/or insecticide ingredient can be included in the plastic film. This can be an ingredient having a specific activity for the particular microorganism which is to be controlled, including bactericides and fungicides. The microcide is included at an effective concentration which is preselected for each specific microcide and is generally from about 0.0001 to about 2 weight percent.

The plastic film can have a thickness from about 0.1 to about 10 mils, preferably from about 0.5 to about 5 mils, and most preferably from 1 to about 3 mils. This film is preformed into a bag and the bag is preferably supported in a rigid mold to impart uniform size and shape to the finished block products.

THE FEED SOLUTION (FOR EXAMPLE)

The animal feed supplement may be from a commercial aqueous feed solution. Generally, this will be a sugar solution, and a variety of sugar solutions can be used; however, molasses is a preferred source. The feed solution should be present in the feed supplement at a concentration of from 30 to about 95, preferably from 50 to about 80, weight percent. The preferred molasses source is commercially available with a sugar content from about 65 to 85 Brix and a consistency that varies from a thin to a thick syrup. The water content of these solutions is from 5 to about 30 weight percent. The molasses can be any sugar containing molasses such as cane or Blackstrap Molasses, beet molasses, converted molasses wood sugar molasses, hydrosyrup, citrus molasses and the like.

Another sugar solution that can be used is whey, a by-product of the dairy industry. The whey is a dilute sulution of lactoalbumin, lactose, some fats, and the soluble inorganics from the parent milk. This whey solution is condensed and spray dried to a powder or is condensed to about 40 to 60 percent solids and preserved. A typical analysis is as follows:

Table 2

Composition of a Typical Dried Whey	
Protein	12.0%
Fat	0.7%
Lactose	60.0%
Phosphorous	0.79%
Calcium	0.87%
Ash	9.7%

A third source of a useful sugar solution is the pulp and paper industry which produces large quantities of by-product lignin sulfonates from wood during the sulfite pulping process. After the separation of lignin, the acidity of the resultant solution is neutralized with an ammonium or alkali metal bisulfite compound or base to form the following organic salts:

Ammonium lignin sulfonate;
Sodium lignin sulfonate; and
Magnesium lignin sulfonate.

A typical analysis of a commercially available ammonium lignin sulfonate solution is as follows:

Table 3

Typical Analysis of Ammonium Lignin Sulfonate	
Percent Solids	50%
Specific gravity	1.237
pH, 10% solution	3.5
Sugars - expressed as glucose	16.0%
Tannin content	45.0%
Available ammonia	3.0%
Sulfur	6.0%
Ash	1.0%

The sugar solution is the energy ingredient of the supplement. Sources of other metabolizable organic values can be used to replace a portion of the sugar solutions. Examples of such other useful energy ingredients sources include condensed and dehydrated molasses solubles which are obtained from the fermentation of molasses to produce chemicals such as ethanol, citric acid, glutamic acid, etc. A material rich in metabolizable values, known as condensed molasses solubles, is obtained by evaporation of the residue from this fermentation. This material can also be dehydrated to dryness and the resultant dry solid is also a useful additive. Another very useful feed solution is a condensed or concentrated fermented corn extract, which is sometimes referred to as corn steep liquor or mazoferm. This material is obtained by concentrating the liquid remaining after steeping corn in an aqueous sulfur dioxide solution and allowing it to ferment. These materials can have from 40 to 100 percent solids and contain, on a dry weight basis, from 1 to 15 percent sugar and contain significant contents of protein, e.g., from 5 to about 25 percent. All, or any portion of the aforementioned sugar solutions can be replaced with these feed solutions, depending on the amount of natural protein which is desired in the final supplement.

THE BUFFER INGREDIENTS (FOR EXAMPLE)

Some buffer ingredients, which also serve to solidify the feed supplement, are sodium carbonate, sodium bicarbonate and mixtures thereof, and magnesium oxide. The carbonate is the preferred carbonate source as it is readily available and less costly than the bicarbonate. Also, the alkaline carbonate neutralizes the acids commonly present in molasses and is thereby converted to a mixture of bicarbonate and carbonate. Other sources of the buffer include sodium sesquicarbonate, which is a hydrated carbonate and bicarbonate double salt. Carbonate ores such as trona ore, which can contain up to 25 weight percent impurities, can also be used provided they are of sufficient concentration and do not contain any toxic impurities. The carbonate/bicarbonate ingredient is used in an amount from 8 to 25, preferably from 12 to 18, weight percent of the supplement.

The second buffer ingredient which can be used is magnesium oxide. Preferably the magnesium oxide has a moderate to high reactivity, as measured by the time required to neutralize a standard citric acid solution. Acceptable magnesium oxides exhibit neutralization times in this standard test which are from 10 to about 150 seconds, preferably from 10 to about 90 seconds. The magnesium oxide can be used in an amount from 2 to 5, preferably from 3.5 to 5, weight percent of the supplement. It is also preferred that the weight proportion of magnesium oxide to the carbonate/bicarbonate be from 1/4 to 1/2, preferably about 1/3. When used in these proportions, the buffer ingredients have the most desirable pH value, and are the most effective as a rummen buffer.

THE PHOSPHATE AND CALCIUM INGREDIENTS (FOR EXAMPLE)

When the supplement blocks are free-choice fed to animals on a high volume diet, their hardness as measured by a laboratory durometer should be about 20 to 45 units. When the supplement should also contain dietary amounts of phosphorus and/or calcium, suitable sources are dicalcium phosphate, defluorinated phosphate rock, calcium carbonate, gypsum, etc., all having limited water solubility. When the blocks should have a hardness of 60 units or greater (as may be required when fed to animals on low to moderate volume diets which would overconsume the softer block), water soluble and reactive sources of phosphate and/or calcium can be used as hardening additives.

The phosphates which can be employed as hardening agents in the feed supplement block can be phosphoric acid or any soluble salt thereof, with the acid being preferred. Examples of useful phosphates include the alkali metal and ammonium salts, e.g., sodium phosphate, potassium phosphate, or ammonium phosphate. The preferred hardening agent is phosphoric acid which can be of any commercially available grade from 50 to 98 percent acid. When necessary to increase hardness, the phosphate is employed in the supplement at a concentration from about 0.5 to about 5.0, preferably from 0.5 to about 3.0 weight percent, expressed as P_{205}.

Calcium sources which can be used as hardening agents can be calcium oxide or hydroxide. Commercially available lime, calcium oxide, is useful in finely subdivided form, typically 90 weight percent or more passing a 125 mesh screen. The more finely subdivided the lime, the faster that it will hydrate and participate in the solidification of the supplement. The lime can be slaked by mixing with water prior to addition to the sugar solution, or if desired, can be added directly to the aqueous sugar solution, depending on the process equipment and controls. When necessary to increase hardness, the amount of the calcium oxide or hydroxide ingredient which is employed can be from 0.5 to about 5.0 weight percent, expressed as the oxide, and preferably is from about 0.5 to about 3.0 weight percent based on the weight of the sugar solution.

THE PROTEIN SOURCE (FOR EXAMPLE)

The feed supplement can also contain a nitrogen source for the animal's protein requirements. The nitrogen can be in proteins which are commonly found in various sources such as: dried blood and meat meal from rendering plants, cottonseed meal, soy meal, rape seed meal, sunflower seed meal, dehydrated alfalfa, dried and sterilized animal and poultry manure, fish meal, liquid or powdered egg, fish solubles, cell cream and rabbit pellets. When the feed supplement is intended for consumption by ruminants, a non-protein nitrogen compound such as ammoniacal compounds, e.g., urea, biuret or mono- or di- ammonium phosphates can be used to supplement the protein requirements. The preferred non-protein nitrogen source is urea which can be added in an amount from 2 to about 15 weight percent, preferably from 5 to 12 weight percent, based on the supplement. In some applications, it is preferred to use all natural protein, and in such instances, a vegetable meal such as cottonseed meal, soy meal, rape seed meal, corn gluten meal, etc. can be used.

The following examples illustrate practice of the invention and will serve to demonstrate results obtainable therewith.

Example 1

Buffer-containing feed supplement samples are prepared by mixing together the following ingredients:

Ingredient	Content No.1	(Weight No.2	Parts) No.3	No.4	No.5
1. Molasses	470	470	470	470	470
2. Urea	20	20	20	20	20
3. Water	100	100	100	100	100
4. Sodium Carbonate	150	--	--	--	150
5. Sodium Sesquicarbonate	--	150	--	--	--
6. Sodium Bicarbonate	--	--	150	--	--
7. Magnesium oxide	50	50	50	50	--
8. Corn gluten	80	80	80	80	80
9. Feather meal	50	50	50	50	50
10. Dicalcium phosphate	50	50	50	50	50
11. Fat (soy oil)	30	30	30	30	30

The supplements are prepared by stirring the mixture of molasses, water and urea and adding the selected carbonate buffer (Ingredient 4, 5 or 6) while continuing to stir the mixture. After the carbonate is completely dispersed, the magnesium oxide is added and the mixture is stirred. The remaining ingredients are then added, the mixture is stirred to disperse these ingredients, and the liquid mixture is poured into small cardboard boxes.

All of the mixing of the ingredients is done at ambient temperature (70°F.). A slight increase in temperature is observed and the temperatures of the final mixure, before pouring, are also recorded and presented below. The boxes are placed in a laboratory oven maintained at 120°F. to simulate the temperature expected in plant practice of the invention.

After 24 hours, the samples are removed from the oven and the following hardness values are observed, when measuring the surface hardness with a durometer having a small diameter pin:

	No.1	No.2	No.3	No.4	No.5
Pour Temperature (°F)	108	106	100	90	86
Hardness	60	40	20	12	<2

Samples 4 and 5 were too soft for application as even well-fed cattle would be expected to overconsume supplement blocks having these hardness values. These blocks were sufficiently soft that one could easily push one's fingers into the product.

Sample 2 had acceptable hardness for free choice feeding. Sample 1 would be acceptable, however, it may have limited consumption if fed to animals on a high volume diet of other feeds. Sample No. 3 would be marginally acceptable, however, over-consumption could be expected in many applications.

The direct relationship between hardness and percent of the carbonate added as bicarbonate, which is apparent from a comparison of Samples 1–3, provides a control useful for final adjustment of the hardness to fit a particular feeding situation. Thus, if the animals do not consume sufficient quantities of the block formulated with sodium carbonate as sample No. 1, some of the sodium carbonate can be replaced with sodium bicarbonate, softening the block.

Example 2

The procedure of Example 1 was repeated to prepare seven additional samples. These samples had the following compositions:

Ingredient	Content (Weight Parts) No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Molasses	470	470	470	470	470	470	470
Water	100	100	100	100	100	100	100
Urea	20	20	20	20	20	20	20
Sodium carbonate	150	150	100	100	75	75	50
Magnesium oxide	40	30	50	35	50	25	30
Di Calcium phosphate	50	50	50	50	50	50	50
Corn gluten	80	80	80	80	80	80	80
Feather meal	50	50	50	50	50	50	50
Fat	30	30	30	30	30	30	30

The pour temperatures, contents of sodium carbonate and magnesium oxide, and the hardness values of the blocks after 24 hours storage at 120°F. are as follows:

Sample	No. 7	No. 8	No. 9	No. 10	No. 11	No. 12	No. 13
Pour temperature, °F:	95	96	103	106	96	93	92
Sodium Carbonate	15	15	10	10	7.5	7.5	5
Magnesium oxide	4	3	5	3.5	5	2.5	3
Hardness	40	30	40	20	25	<2	<2

Samples 12 and 13 are unacceptable, and samples 10 and 11 are marginally acceptable for free choice feeding.

Example 3

The procedure was repeated with the formulation of Sample No. 13, however, limited amounts of lime and phosphoric acid were included. The formulation was as follows:

Ingredient	Content (Weight Parts) No. 14
water	100
lime	10
molasses	470
urea	20
phosphoric acid	20
sodium carbonate	50
magnesium oxide	30
corn gluten	80
feather meal	50
dicalcium phosphate	50
fat	30

The water and lime are mixed to hydrate the lime, and the molasses and urea are then added. After these ingredients are mixed by stirring, the phosphoric acid is added and after it is neutralized, sodium carbonate is added and the mixture is stirred. Magnesium oxide is then added. After stirring the magnesium oxide into the liquid, the remaining ingredients are added. The pour temperature of the liquid is 106°F.

After 24 hours at 120°F. the laboratory sample is inspected and observed to have a hardness value of 20, thus indicating that the lime and phosphoric acid significantly increased the hardness from that observed for sample No. 13.

Example 4

A feed supplement is produced in commercial quantities in a commercial plant mixer. The following ingredients are mixed into the supplement:

Ingredient	Content (Weight Percent)
Water	10.0
Molasses	47.6
Urea	1.3
Sodium Carbonate	15.0
Magnesium Oxide	5.5
Corn gluten	8.0
Feather meal	5.0
Dicalcium phosphate	5.0
Fat (Soy oil)	2.5
Vitamin mix	1.0

The formulation provided the following nutrients:

Crude Protein		14.0
NPN	not more than	3.8
Calcium		1.2
Phosphorus		1.1
Carbonate buffer*		17.0
Magnesium oxide		5.5
Fat		2.5

*a mixture of carbonate-bicarbonate hydrated salt

The ingredients were mixed in a plant batch mixer using the procedure of addition of Example 1. After all the ingredients had been added, the temperature of the final mixture was 102°F. The mixture was poured into 250-pound cardboard molds which were lined with bags of polyvinyl alcohol film having a thickness of 0.002 inch. After filling, the plastic film was folded across the top surface of the supplement, and the molds were covered and moved into a warehouse. During storage ovrnight, the temperature of the supplement mixture in the molds reached a maximum value of 165°F. After overnight storage, the cardboard molds were removed and the solid supplement block was entirely sealed in the plastic film. The solid supplement had a hardness value of 35.

The resultant blocks were fed, free-choice, to a test group of high producing Holstein cows, milked three times daily and on a full feeding program. Six pens of cows were provided with the supplement block; one pen contained 80–90 fresh cows; another pen contained 100 cows with at least 100 days in lactation; three pens contained 78 mature milking cows each; and two pens contained 78 first-calf-heifers each. A wooden fruit bin 4 feet X 4 feet and 3 feet high was placed in each pen and four to five supplement blocks were placed in each bin, and replenished as consumed.

The cows consumed the supplement blocks at a rate adequate to supply from 0.2 to 0.3 pounds of the buffer ingredients per day to each cow. The lowest consumption was by the fresh cows which consumed the block at an average rate of 0.84 pounds per head per day. This was expected, as during the progress of the test cows were moved from this pen to the other test pens, and fresh cows, unfamiliar with the supplement, were added to the fresh cow pen. The three pens of mature cows consumed the supplement block at a rate of 1.44 pounds per head per day; the pen of 100-lactation-day cows consumed the supplement block at the rate of 1.36 pounds per head per day, and the cows in the remaining pens consumed the supplement blck at a rate of 1.21 pounds per head per day. The feeding test was continued for one month.

Since the cows were under a full feeding program with an average of eight feedings per day of silage, hay and grain, it was not expected that they would consume the block at the necessary rate of about 1.2 to 1.6 pounds per head per day. Contrary to expectations, the aforementioned consumption rate was unexpectedly high and was sufficient to supply the cows with the necessary quantity of buffers. The daily feeding regimen was as follows:

Time	Ration	Quantity per head
0600 - 0630	grain mix	12.5 pounds
	corn silage	15.0 "
0730 - 1200	alfalfa	4.5 "
1400 - 1700	grain mix	12.5 "
	corn silage	15.0 "
2100	alfalfa	4.5 "
	silage	to excess of consumption

The grain mix contained cottonseed meal, whole cottonseed, shredded beet pulp, wet corn gluten, liquid supplement and mineral mix.

In addition to the above feedings, the cows were also fed a total of 10 pounds of steam rolled barley, consumed during the three milkings each day. The average daily consumption of these feeds was 79 pounds per cow per day.

The formulation and hardness of the suppement block provided the proper palatability to insure adequate consumption on a free-choice basis under the most critical situation, i.e., with cows which were fed all they could eat of other feeds.

Example 5

A feed supplement is prepared by preheating molasses to a temperature of 150°F. The preheated molasses is introduced into a mixing vessel and stirred while adding urea, magnesium oxide, calcium phosphate, salt and corn gluten meal at the following proportions:

Table 6

Ingredient	Weight Percent
Molasses	70
Calcium Phosphate	5
Salt	3
Corn gluten meal	10
Magnesium oxide	12

The supplement is maintained at 150°F during mixing of the ingredients and is then poured directly into bottomless cylindrical molds lined with plastic bags formed from a film with a thickness of 0.002 inch.

Each mold is formed of two halves which join along the longitudinal midline of the assembled form. The joined edges have continuous edge flanges which are clamped together to assemble the form. The forms are made of fiberglass reinforced plastic and are surrounded by an outer jacket of polystyrene fam insulation approximately 1 inch thick.

The forms rest on a smooth surface pallet and the plastic bags are placed, one each within each form, with the top of each bag extending above the top of its form. Four molds are placed on each pallet and the pallet is moved to the packaging station of the block plant.

After each bag is filled, the upper end of each bag is folded closed, against the top surface of the liquid contents in the bag, and an adhesivly backed label is applied over the folds.

Each pallet, which supports four filled molds, each containing 500 pounds of block ingredients, is moved into a heated storage room, maintained at 135°F. The next morning, the blocks are moved into the warehouse, the mold clamps are released and the molds are removed, leaving four glossy surfaced molasses blocks, each weighing 500 pounds, on each pallet. The blocks are completely finished and ready for shipment.

Example 6

A feed supplement is prepared by mixing water and lime to prepare a slurry containing 33 weight percent calcium, expressed as lime. The hydration of the lime raises the slurry temperature to 190°F., and cane molasses is then added to prepare a mixture ontaining about 84 percent cane molasses. Dry urea and salt are then added, followed by magnesium oxide, corn gluten, and fat. The mixture is stirred for ten minutes and is then poured into bottomless molds lined with plastic bags having a 2 mil thickness. The molds have an octagonal cross section. The molds are approximately 20 inches tall and 22 inches in width, and each mold is filled with 250 pounds of supplement. The molds are stacked on a pallet with four molds on the pallet,

filled and the top edges of the plastic bag in each mold are folded against the surface of the liquid contents and an adhesive label is placed over the folded edges. A plywood divider is placed over the molds and a second layer of plastic-bag-lined molds is stacked on the plywood divider and filled in the same manner.

The pallets are moved into an unheated warehouse and the temperature of the supplements monitored. When the temperatures of the supplements in the molds reach 165°F, the insulating jackets are removed from the molds. The following morning the molds are removed, leaving pallets, each supporting two layers of supplement blocks, four blocks in each layer. The blocks have a glossy appearance and appear dark brown through the transparent plastic covering.

The blocks have the following ingredients:

Table 8

Ingredient	Weight Percent
Cane Molasses	54.2
Corn Gluten Meal	14.0
Water	6.0
Urea	5.0
Fat	4.6
Salt	4.5
Magnesium Oxide	4.5
Phosphoric acid (75%)	4.0
Lime	3.0
Vitamins and Trace Minerals	0.2

The blocks are ready for shipment into the feed distribution system without any further treatment. They are supplied for free choice feeding by placing one or more blocks at selected locations on catte ranges, and the outer plastic film is stripped from the blocks when they are placed on the range. Since the blocks are highly weather resistant, they withstand rains without any significant loss.

The blocks also have an extended storage life in the distribution system. The plastic outer covering is impermeable to oxygen and the blocks can be stored under high humidity conditions without developing any mold. Since the plastic outer covering also resists moisture transfer, particularly at low humidity conditions, the blocks can also be stored under hot and/or dry conditions without experiencing any significant loss of moisture and without cracking.

The invention has been described with reference to some preferred and illustrated embodiments. It is not intended that the invention be limited by the disclosure of the preferred embodiments. Instead, it is intended that the invention be defined by the method steps, and ingredients, and their equivalents set forth in the following claims and abstract.

CLAIMS

1. The method of preparing an animal feed supplement in solid block form which comprises:
(a) admixing an aqueous feed solution e.g. selected from the group consisting of aqueous solutions of sugars, proteins and mixtures thereof, with solidifying and nutrient ingredients to prepare an aqueous supplement liquid which contains e.g. from 10 to 35 weight percent water;
(b) placing a plstic bag formed of a water soluble plastic film e.g. having a thickness from 0.1 to 10 (e.g. 0.5 to 10) mils and formed of a plastic e.g. selected from the group consisting essentially of polyvinyl alcohol, polyvinyl acetate, ethylene-vinyl acetate copolymers and alkyl cellulose esters, into e.g. a vertical-walled form;
(c) pouring the aqueous feed supplement liquid mixture into the plastic bag; and
(d) storing the mold containing the feed supplement to permit its contents to solidify; and
(e) stripping the vertical-walled form from the resultant solid block to recover a solid block entirely covered by said plstic film.

2. The method of claim 1 wherein said feed supplement is poured into said plstic bag at a temperature from 110° to 135°F.

3. The method of claim 1 wherein said film also includes a microcide in an effective concentration from 0.0001 to about 2 weight percent.

4. The mothod of claim 1 wherein said mold is bottomless and is placed on a pallet and said plastic bag is placed within said mold.

5. The method of claim 1 wherein said mold is a cylindrical mold with a longitudial split and is joined along the longitudinal split into said vertical-walled form, and said step of stripping said form from said solid block comprises the steps of separating the joined longitudinal edges to

spread the mold and remove it from the block.

6. The method of claim 1 wherein said plastic is polyvinyl alcohol.

7. The method of claim 1 wherein said plastic has a thickness from 0.001 to about 0.005 inch.

8. A method of feeding ruminents which comprises:

(a) preparing a solid feed supplement having a total water content from 10 to 35 weight percent and comprising from 30 to 95 weight percent of a feed solution containing 40 to 95 percent solids comprising sugar, protein, or mixtures thereof by adding, to said feed solution, solidifying and buffering ingredients consisting essentially of sodium carbonate, sodium bicarbonate, and mixtures thereof in an amount from 8 to 25 weight percent of said supplement, and from 2 to 5 weight percent magnesium oxide;

(b) providing said solid feed supplement to the ruminent for free choice consumption; and

(c) controlling the free choice consumption of the feed supplement at a level from 1 to about 4 pounds per day by maintaining the quantities of said solidifying and buffering ingredients at the amounts sufficient to impart a preselected hardness to said solid feed supplement.

9. The method of claim 8 including the step of incorporating from 3.5 to 5 weight percent magnesium oxide in said supplement.

10. The method of claim 8 wherein said sodium carbonate, sodium bicarbonate or mixtures thereof are added in an amount from 12 to 18 weight percent of said supplement.

11. The method of claim 8 wherein a mixture of sodium carbonate and sodium bicarbonate is added in proportions from about 4/1 to 1/4 weight parts carbonate to bicarbonate, and said step of controlling the consumption of the feed supplement is practiced by adjusting the proportions of carbonate to bicarbonate which is added to said feed solution.

12. The method of claim 8 including the step of incorporating a nitrogen source in said feed supplement solid in an amount from 1 to 35 weight percent, expressed as protein.

13. The method of claim 8 wherein the non-protein-nitrogen content of said protein source is no greater than 90 weight percent of the total protein source, expressed as equivalent protein.

14. The method of claim 8 wherein said protein source comprises a ruminent by-pass protein.

15. The method of claim 8 wherein said by-pass protein is feather meal.

16. The method of claim 8 wherein said by-pass protein is blood meal.

17. The method of claim 8 wherein said by-pass protein is a mixture of corn gluten meal and feather meal.

18. An animal feed supplement, according to claim 1 or 8, substantially as described in any of the Examples.

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